

# WG Name, Charge and Scope

## CWP WG: Visualization

### Charge and scope:

Visual representation of event data overlaid with detector geometry for the purpose of HEP research, education and outreach. This representation can be static (event displays) or animated.

Three key features characterise software applications targeted at visualization for HEP experiments:

- **Event based** - applications access experimental data on an event-by-event base, visualizing the data collections belonging to that particular event
- **Interactive** - applications offer different interfaces and tools to users, in order to interact with the visualization itself, selecting event data and setting cuts on objects' properties; those actions can be automated, when the user's settings are stored
- **Geometry visualization** - applications show some sorts of detector geometry; that can be the real geometry of the detector, when retrieved from the experiments' software frameworks, or a simplified description, usually for the sake of speed, resources savings or portability

## CWP WG: Visualization

### Out of scope:

Other types of data visualization used in HEP experiments -- like **histograms** and other statistical plots used in data analysis, and data visualization for **slow control** -- are considered out of scope and they will be not discussed in this chapter.

# Key challenges and opportunities - I

- Improve visualisation **tools and techniques** for the support of the following use cases:
  - detector design (*geometry browser*)
  - simulation and reconstruction development
  - physics analysis
  - Outreach & education

# Key challenges and opportunities - II

- Improve support for required **platforms and devices**, used by the experiments and the end-users (*e.g. Linux distros, Laptops, mobiles*)
- Ensure sustainability and maintainability for **key software packages** (*e.g. the graphics libraries used in HEP viz tools*)
- Contributing to improve **low latency access to data**, low entrance cost (*In collaboration with other WGs*)
- Improve **rendering** performance

# Big ideas: Common tools

- Finding **common needs**
- **Collaborative work** towards common tools which can be used as “base packages”, or as “base building blocks”
- Of course all experiments have specific needs and physics objects, but the core packages used in visualisation tools could and should be common:
  - **Shared knowledge**, know-how and development work
  - **Shared maintenance**

# Big ideas: Common data-exchange format

- In order to work toward common tools, we first need to identify a **common background** to start from
- The discussion at the **two topical workshops** allowed us to start the design of a **common data-exchange format**, to be used by common tools
- The Experiments would provide specific **exporters** to communicate with the specific application inside the experiments' frameworks

# Big ideas: Client-Server approach

- Now, many experiments have custom viz tools within the experiment's SW framework
- Going towards a **client-server approach** could allow us to write common tools which could interact with specific modules running inside the experiments' framework. That would ensure both:
  - Ability to access experiment-specific data
  - Ability to use common approaches, techniques and tool

# Big ideas: Collaborative platforms

- Nowadays many platform are collaborative: different users can access data and work on them in a collaborative way (like Google Docs)
- We would like to explore the possibility of having a **collaborative environment** for event data visualisation as well
  - Easy to use
  - Flexible
  - Multi-users



# Practical consideration for Progress in the WG Area

- *How will the proposed activities empower HEP physicists to get the most physics out of the experiments during the HL-LHC era? What new physics might these bring?*
  - Visualization is **used at all stages of the HEP data-chain**, from checking the simulation to develop reconstruction algorithms, from the development of new sub-detectors to the event checking in physics analysis
  - Thus, it has a **key role** in many HEP activities, helping in exploiting new techniques and new data

# Practical consideration for Progress in the WG Area

- *What are the proposed R&D activities over the next 5 years toward these applications?*
  - Agreeing on a **common data-exchange** format, plus exporters for the different experiments
  - Designing and building **common base packages**
  - Designing and building new **client-server** and/or **collaborative** tools
  - New **rendering techniques**
  - Usage of new **graphics engines** and techniques

# Commonality and Leveraging S&C beyond HEP domain

- Finding **common techniques**, approaches, best practices and needs among HEP experiments
- Many scientific fields need complex visualization: **Medicine, Geology, Engineering, ...** New collaboration could be started with them, to know the common issues and to **share knowledge**
- **Industries** like video games, automotive and medical equipments are driving the **R&D in computer graphics, Virtual Reality, User Interfaces** and **interactive** data visualization

# Cross-cutting Elements

- **Simulation WG and Math Libs WG** - geometry representation, geometry libraries
  - Visualization needs efficient and possibly common geo representation
- **Frameworks WG** - data access
  - Needs **easy access to data**. Nowadays access to data is very painful in many experiments: users need to use the experiments' SW frameworks and/or Grid tools to access and retrieve events.
  - Data should be accessible like locations and addresses in *Google Maps* (geo-coordinates  $\longleftrightarrow$  run-event)

# CWP Chapter Status and Plans

- *What is the status of the CWP Chapter? Are the key ideas and R&D in place?*
  - We organised **2 topical workshops** to discuss, build and shape the content of the chapter. **Key ideas** are in place.
- *What additional work is required to get the prose in good shape for a viable CWP chapter and for others outside of your WG to read and comment?*
  - The actual text of the chapter has to be written, from the bulleted lists which store the content of the different sections

# CWP Chapter Status and Plans

- *How do you plan to complete your chapter? What do you expect to accomplish by the end of this workshop?*
  - During the Visualisation parallel session we will better shape the actual text of the chapter
  - Then, we will finalize the writing in the next few weeks

# Auxiliary Material



# Visualization WG: Primary Activities

- **Two topical workshops** organised, and held at CERN, to:
  - Present the status of the field, **from HEP** but also with invited speakers from the **industry** (NVIDIA, Qt Company, KDAB)
  - Present current **solutions** and faced **issues**
  - Finding **commonalities** among the experiments
  - Propose solutions to common problems
  - Planning **future collaborative work**, toward **common**

*Topical workshops:*

3 days

<https://indico.cern.ch/event/617054/>

1 day

<https://indico.cern.ch/event/628675/>



# Visualization WG: Main Contributors

